INTERNAL RUNNING ELEVATOR

This invention relates to a system and tool for handling and lifting oil & gas well casing sections / strings during connecting and installation or extraction and removal of casing / conductor, production casing, risers, drill strings, or other tubular goods, in a well / bore hole. This invention also encompasses a method for use of a lifting tool for this purpose.

Background of the Invention

Lifting and joining of pipe lengths to a standing pipe string with current technology is a time consuming and complicated task. Existing solutions require that a lifting apparatus for pipe lengths, to be installed on a top drive mounted pipe handling machine or derrick crane, and removed for each pipe length to be joined. Between lifting operations a drilling fluid, for example drilling mud, is circulated with special purpose equipment to maintain pressure in the bore hole. After each lifting operation and removal of the lifting tool, drilling circulation equipment must be installed on the top drive or derrick crane. When the next casing section shall be lifted into place, the drilling fluid circulation equipment must be removed and the lifting tool re-installed. This is a costly time consuming process, which commonly requires 4-5 hours to complete.

There is a need for a lifting system and tool, which reduces the time required to complete the lifting and joining procedure to an absolute minimum, where the lifting and joining operation is performed with the same tool. There is also a need for the ability to circulate drill fluids via the lifting tool without the requirement to install additional equipment. Furthermore there is a need for a lifting tool which can handle varying pipe sizes / diameters.

Description of Prior Art

Known methods of lifting and joining pipe lengths utilise a primitive chain and hook system for grasping and lifting the connecting nipple. A nipple is configured for connection to and from a threaded end of a pipe length to be lifted. The pipe section together with the installed nipple can be lifted by a chain and hook system as illustrated in fig. 15, which shows a nipple installed and removed at the top of a threaded pipe length.

Figure 16 illustrates a lifting clamp of known art positioned near the upper end of a casing length which is equipped with a protecting nipple at the top and coupling at the bottom. The nipple and coupling are removed from the casing held in place in the drill deck before lowering of the casing section.

Figure 17 illustrates how a casing section end is grasped with a clamp according to known art and how the casing length and casing string are screwed together with power tongs. The applicants' Norwegian patent, NO 307876, relates to a lifting tool for lifting of pipe lengths / lengths. The lifting tool according to NO 307876 encompasses a separate entry section or elastomer / elastomer-composite packing which expands upon activation of the lifting tool against the inside diameter of the casing section to be lifted. This lifting tool however is not configured for rotation about its' axial axis or for circulation of drilling fluids.

Summary of the Invention

The invention includes three versions of a lifting tool for handling of a pipe length during joining, lowering, or removal and disassembly of conductor, casing, risers, drill strings or similar in a bore hole or well as stated in claims 1, 37 and 55.

The invention also encompasses a lifting system for lifting or lowering pipe lengths (3,4) and drill string (2), during joining and lowering or removal and disassembly of

conductor, casing, risers, drill strings or similar in a bore hole (160) or well (160) as stated in claim 74.

Finally the invention includes a method for lifting of pipe lengths for joining such (3,4) to a pipe string (2), similarly for casing, risers, drill strings or similar in a bore hole or well (160) as stated in claim 82.

The lifting system and lifting tool according to the invention have several advantages; the ability to lift a pipe length for joining with a standing pipe string, the ability to rotate about the tool axis for joining of the pipe length with the pipe string, and the possibility of filling or circulating drilling fluid to the bore hole via the lifting tool. The lifting tool can also be used with several different pipe dimensions.

Additional advantages and details of the invention are stated in the listing of dependent claims.

Brief Description of the Drawings

The drawings (figures) illustrate a lifting tool according to the invention in a first version where the lifting tool is oriented within the inner diameter of the pipe length to be lifted (Internal Running Elevator, IRE), a second version where the lifting tool includes an internal running nipple (Internal Running Nipple Thread Elevator, INTRE) and a third version where the lifting tool is external running (External Running Elevator, ERE).

Figure 4a-b to figure 12a-b, where the method for lifting and joining of a pipe length and pipe string are illustrated, show the IRE and INTRE configurations of the lifting tool. The method can be illustrated with similar figures for the ERE configuration of the lifting tool.

Fig. 1a - is a schematic partial section view of the lifting tool according to the

invention, here shown in the internal running configuration (IRE)

Fig. 1b - is a schematic partial section view of a part of fig. 1a which shows the details of a central piston rod and hydraulic passages for the lifting tool.

Fig. 2a-b - is a schematic partial section view of another configuration of the lifting tool according to the invention, here shown in a configuration where the lifting tool encompasses a lifting nipple which is threaded into the end of a pipe length to be lifted (INTRE). Fig. 2a shows a lifting tool in the deactivated condition, ready to grip the end of a pipe length, and fig. 2b shows a lifting tool in the activated condition.

Fig. 3a-c - is a schematic section view of another configuration of a lifting tool according to the invention, here shown in a configuration where the lifting tool has a chuck (wedge) mechanism which grips the pipe length end on the outside diameter. Fig. 3a shows the lifting tool in the deactivated condition ready to grip the end of a threaded pipe length, fig. 3b shows the lifting tool in the activated condition.

Fig. 4a-b - is a schematic partial section view of a lifting tool according to the invention, where the lifting tool positions of engagement (near horizontal) and vertical are shown.

Fig. 5a-b - is a schematic partial section view showing the lifting tool in the deactivated condition, and a pipe length which is to be joined with another section or string, where the section to be joined is positioned in a tube feeding machine (TFM) and ready for engagement of the lifting tool.

Fig. 6a-b - is a schematic partial section which illustrates a lifting tool ready for engagement with the end of a pipe length.

Fig. 7a-b - is a schematic partial section view of the lifting tool activated with the end

of a pipe length, achieved by moving the pipe length forward in the sub-horizontal position and into the end of the lifting tool.

Fig. 8a-b - is a schematic partial section view of the lifting tool in the activated condition with a magnified partial section view of the lifting tool.

Fig. 9a-b - is a schematic partial section view of the lifting tool lifting the end of the pipe length such that the opposite end slides toward another section or string (2).

Fig. 10a-b - is a schematic partial section view where the lifting tool has lifted the pipe length to an almost vertical position where it can be made ready for joining with the other section or string (2).

Fig. 11a-b - is a schematic partial section view showing how the first pipe length is joined with the other section with the help of the lifting tool according to the invention.

Fig. 12a-b - is a schematic partial section view which shows the pipe length in the lowered position held by a Power Slip in the drill floor. The lifting tool can then be disengaged from the pipe length, and positioned to receive the next pipe length from the pipe handling machine.

Fig. 13 - is a schematic view of a top-plate-unit according to the invention emobodiment of lifting tool with lifting nipple.

Fig. 14 - is a schematic section view of one possible configuration of the piston rod, where the lifting tool encompasses an internal running lifting nipple. The piston rod in this configuration has hydraulic oil passages connecting the nipple rotation system to the lifting tool hydraulic system, a passage for drilling fluid, drilling mud, cement or other fluids, and a passage for venting of air during the fluid circulation process.

Fig. 15 - shows an installed and removed nipple of known art on the end of a threaded pipe length, and a primitive chain and hook system for grasping and lifting of the nipple.

Fig. 16 - illustrates a lifting clamp of known art, placed near the upper end of a pipe length, where the pipe length is equipped with a protective nipple on the top and a coupling on the bottom, where the coupling on the bottom is removed and the nipple on the top of the standing pipe length in the drill floor is removed prior to lowering.

Fig. 17 - shows how a pipe length is held in position with the help of a clamp of known art and how the pipe length and string are screwed together with the help of power tongs.

The invention will now be described with reference to the attached drawings listed above.

Detailed description of the invention, with preferred embodiments.

Lifting Tool with Internal Running Lifting Nipple (INTRE)

Fig. ____ shows a schematic partial section view of a configuration of the lifting tool according to the invention, here shown in a configuration where the lifting tool encompasses a lifting nipple which is screwed into the end of a pipe length to lifted (INTRE). Fig. 2a shows the lifting tool in the inactive / deactivated condition, ready to connect to the threaded end of a pipe length, and fig. 2b shows the lifting tool in the activated condition.

The lifting tool can manipulate and lift oil & gas well casing strings (2) and sections (3,4) during connecting and installation or extraction and removal of casing or conductor, casing, risers, drill strings, or other tubular goods, in a well (160) or well bore (160). The lifting tool consists of a lifting part (20) with a coaxial piston rod (47), a mounting interface part (5) for connection to a top drive (60) providing lifting force, or derrick crane (60), and a hydraulic system (40) which is designed to hold the lifting part (20) fixed to either the inner or outer diameter of the end of the pipe length (3).

The novel aspects of this lifting tool are the lifting nipple (32) with a coaxial multi-passage tubular lifting nipple axel (36), a lifting nipple cone (37), and a lifting nipple flange (33), which is positioned between the lifting nipple axel (36) and the lifting nipple cone (37) and designed to transfer load to the lifting tool. The lifting nipple (32) is situated concentrically about the piston rod (47) and arranged for movement along the piston rod (47). Furthermore the lifting nipple (32) is arranged to carry all or part of the weight of the pipe length (3,4) or the resulting joined pipe string (2).

The lifting nipple (32) entering cone or lifting nipple cone (37) is equipped with external helical threads (34) such that it can be threaded in or out of the end of the pipe length (3,4).

The lifting part (20) in a preferred embodiment can be arranged for rotation about the piston rod (47) axis, such that the lifting part (20) with the pipe length (3,4) is capable of a controlled threading of the pipe length (3,4) into a standing pipe length or pipe-string (2), and where the lifting part (20) after the pipe length (3,4) joining with the pipe-string (2) is designed to hold the completed pipe length-sting (2) total weight.

An additional advantage provided by the lifting tool according to the invention is that the lifting part (20) can be rotated about a horizontal axis and configured for connection to a horizontal or nearly horizontal pipe length (3,4). The rotational movement of the lifting tools lifting part can be achieved by fixing the lifting tool in a rotary bearing in the lifting device (70), which engages the piston rod (47), preferably in a recess or lifting shoulder (13) on the piston rod (47). A tilting arm (10) can facilitate rotation of the lifting part (20). The tilting arm (10) in one embodiment has one end (10a) arranged concentrically around the piston rod (47), and the other end (10b) which is connected to a telescoping hydraulic lifting cylinder (61) mounted on the top drive (60), preferably with a chain or other suitable connection.

The lifting tool lifting part (20) can preferably include a locking mechanism, where locking slots (5a) are oriented concentrically around and connect to the piston rod (47), where the tilting arm (10) is movable under pressure, preferably with a spring loaded joint (10a) in the tilting arm (10), and where the movable tilting arm (10,10a) is arranged for movement from an initial unlocked position passively engaging upon rotation of the lifting part (20) in one of the locking slots in the slotted flange (5a) to a locked position, preventing rotation of the entire lifting tool.

The spring loaded joint (10a) is arranged for unlocking the tilting arm (10) upon retraction of the spring loaded joint (10a) from a position where the lifting tool lifting part (20) has moved from an initial position and returned to the initial position.

An additional advantage provided by a lifting tool according to the invention is that circulation of drilling fluids, cement or other fluids to the bore hole or well (160), can be achieved via the lifting tool. Drilling fluid can for example be supplied via a flexible hose (7) at the lifting tools support anchor (5) and via the piston rod (47) within the lifting tool lifting part (20). The lifting tool lifting part (20) can for this purpose encompass a connector (6) which is attached to the flexible hose (7), preferably a high pressure hose (7) with the help of a union (7a) and a bolted goose neck connection (8), preferably with a swivel, for transfer of drilling fluid, drilling mud, cement or other fluid to the piston rod (47) in the lifting part (20), connected to a manifold or adapter (9) for venting of air during application of drilling fluid, drilling mud, cement or other fluid form the top drive (160).

Figure 14 shows a section view of one embodiment of the piston rod (47) in the lifting tool, where the piston rod encompasses an axial cylindrical passage (147) designed for flowing drilling fluid, drilling mud, cement or other fluid and another axial cylindrical passage (148) for venting of air during the application of drilling fluid, drilling mud, cement or other fluid.

In a preferred embodiment of the invention, the lifting tool lifting part (20) encompasses an additional housing (16) with a top plate unit (17) or top plate (21). This housing (16) is arranged with a main lifting shoulder (18) and a bottom plate (19). The top plate unit is shown in figure 13, and can in one possible embodiment include at least one, and preferably two circular plates (17a,b), each with a center hole, with one or more web sections (17c) arranged to stiffen the top plate unit (17) and arranged principally normal to and between the top plates (17a,b), and where the web sections (17c) are attached to the top plates

(17a,b) by welding, a mounting plate (149) arranged on the outside of the upper top plate (17a), and a self-lubricating bushing (21a) arranged between a lifting flange (48) on the piston rod(47) and the other top plate (17b). The lifting flange (48) is among others arranged to transfer load from the lifting tool piston rod (47) to the lifting tool lifting part (20).

To rotate the lifting nipple (32), the lifting tool lifting part (20) can include a nipple rotation system (90), which is arranged for screwing the lifting nipples' (32) nipple cone (37) in and out of the threaded end of a pipe length (3,4), which is to be lifted or loosened. The nipple rotation system (90) can include one or more hydraulic motors (91), each equipped with a gear sprocket (93) mounted on a gear sprocket axle (94).

The lifting nipples' (32) lifting nipple axle (36) can also be arranged with external splines (36a) and engaged by one or more gear sprockets (93) of the nipple rotation system (90) to provide rotation.

The top plate unit (17) can include a cylinder (17d), preferably with a rotary hydraulic port coupling (17e), for inlet (95), outlet (96) and case drain (97) for hydraulic oil from the nipple rotation system (90), where the cylinder (17d) is arranged concentric to the piston rod (47) and radially centered in the end plates (17a,b). The lifting part (20) can also include a cylindrically formed coaxial bearing cylinder (22) with a top plate (22a) and a steering / stop plate (22b), where the coaxial bearing cylinder (22) is arranged to guide the lifting nipple (32) into the correct position for screwing into the pipe length (3,4). The main lifting shoulder (18) on the lifting tool housing (16) is preferably arranged to rest against the steering / stop plate (22b) when the lifting tool is activated, and where the steering / stop plate (22b is arranged to rest against the lifting nipple flange (33) when the lifting nipple (32) is screwed in to the threaded end of the pipe length (3,4).

The nipple rotation system (90) can be attached to the coaxial bearing cylinder (22) with the use of one or more attachment brackets (92).

For centering of the lifting tool in the pipe length (3,4), the lifting tool lifting part (20) can also include a coaxial guide tube (38), which is arranged concentric to the piston rod (47). The lifting nipple (32) then can be arranged concentric to the coaxial guide tube (38) and the lifting nipple is then arranged to move along the coaxial guide tube (38) during the in and out screwing of the pipe length (3,4). There can be arranged external threads (38a) on the coaxial guide tube (38) to engage with the internal threads (35) on the lifting nipple (32).

The coaxial guide tube (38) can be attached to a spring compensation system (39) to accommodate tension forces between the lifting nipple cone (37) external threads (34) and the internal threads (3a) in the end of the pipe length (3,4), and between the lifting nipple (32) internal threads (34) and the external threads (38a) on the coaxial guide tube (38). The spring system (39) can for example consist of two or more helical springs (39) or a spring flange (38).

The lifting tool lifting part (20) can also encompass an entry cone or expanding packing (142) (mud packer), preferably consisting of an elastomer element (140), arranged concentrically about the piston rod (47), configured for entry into the end of a pipe length (3,4) and to expand against the internal diameter of the pipe length (3,4) upon activation of the lifting tool. The entry cone (140) can be attached to the piston rod with the use of a bolted connection (143,144) or another appropriate attachment method. The lifting part can also include an entry cone (141) with a pliable support ring (146), where the entry cone (141) is configured to enclose the end of the pipe length (3,4) or pipe-string (2,3,4), contact and clamp the outside diameter of the pipe length or pipe-string (2,3,4).

The lifting tool hydraulic system (40) is preferably a double acting hydraulic cylinder mechanism consisting of a hydraulic cylinder (42) with a cylinder base (44) and cylinder head (41) and a piston (43) arranged concentric and attached to the axial piston rod (47).

Activation of the lifting tool can by accomplished by supplying pressurised hydraulic oil via a preferably radial inlet (50) in connection with the anchor part (5) and via a primarily vertical hydraulic passage (51) for hydraulic oil through the piston rod (47) and with a radial outlet for the hydraulic oil from the piston rod (47) under the piston (43) to activate the piston (43) upwards. Similarly, deactivation is achieved when pressurised hydraulic oil is supplied from the hydraulic cylinder (42) upper part over the piston (43) to drive the internal clamp rings (29) downwards such that the outer clamp segments (24) with friction coating (27) are retracted from and release their grip on the inner diameter of the pipe length (3,4).

The hydraulic system can also include a supply passage (51) for hydraulic oil to one side of the hydraulic piston (43) in the hydraulic cylinder (42), and an outlet passage (52) for hydraulic oil to the other side of the piston (43) in the hydraulic cylinder (42), where the inlet passage (51) and the outlet passage (52) run through the piston rod (47) from the manifold (9).

The hydraulic cylinder (42) with the cylinder base (44) is preferably connected to one side of the bearing cylinder (22) top plate (22a), and where the spring system (38) with the coaxial guide tube (37) is connected to the bearing cylinder (22) top plate (22a) on the opposite side of the hydraulic cylinder (43) and cylinder base (44).

The lifting tool lifting part (20) includes a clamp system which is arranged to grip a pipe length or pipe-string (2,3,4) which is to be lifted, and where the clamp system consists of at least one set of opposing outer clamping ring segments (24) and inner clamp ring segments (29), preferably with a sealing segment or seal ring (29a) arranged on one side of the inner clamping segment (29), which seal against the outer diameter of the pipe length or pipe-string (2,3,4), and where the pipe length or pipe-string (2,3,4) inner diameter is engaged by the entry cone (140).

There can be arranged an indicator or sensor system as a part of the lifting tool lifting part (20). The lifting part (20) can for example include one or more independent sensors (15),

preferably spring loaded pressure sensors, for determination of the lifting nipple (32) position with reference to the end of the pipe length (3,4), and where each sensor (15) is connected to a limit switch (14).

The outer housing (16) can also include one or more inspection ports. This can be an advantage both for normal inspection and in the event of a mechanical failure in the nipple rotation system (90) or the lifting nipple (32) has become stuck or jammed. Should the lifting nipple become stuck a manual release system can be used. This system encompasses one or more lugs or slots on the lifting nipple flange (33), for manual manipulation with the use of pry bars or levers.

Internal Running Lifting Tool (IRE)

Fig. 1a is a schematic partial section of a version of a lifting tool according to the invention, here shown as a lifting tool with internal running lifting part (IRE). Fig. 1b is a magnified schematic section view of fig. 1a, which shows details of a central piston rod (47) and a part of the hydraulic system (40) of the lifting tool.

The lifting tool can manipulate and lift oil & gas well casing strings (2) and sections (3,4) during connecting and installation or extraction and removal of casing or conductor, risers, drill strings, or other tubular goods, in a well (160) or bore hole (160). The lifting tool consists of a lifting part (20) with a coaxial piston rod (47), a mounting interface part (5) for connection to a top drive (60) providing lifting force, or derrick crane (60), and a hydraulic system (40) which is designed to hold the lifting part (20) fixed to the inner diameter of the end of the pipe length (3).

The novelty of this lifting tool is that the lifting tool lifting part (20) includes a clamping system with internal clamping segments or clamping rings (29) attached to the piston rod (47), where the internal clamping segments or clamping rings (29) are configured

to move in an axial direction inwards under the outer clamping segments (24) and thus press the outer clamping segments (24) radially outward, where the outer clamping segments are equipped with radially oriented friction surface (27) to grip the inner diameter of the pipe length (2), where the outer clamping segments (24) are pressed directly or indirectly by a top plate (21) which a hydraulic cylinder (42) connected to the top plate (21), and where the hydraulic cylinder (42) piston (43) is fixed to the piston rod (47) which itself drives the inner clamping rings (29) upwards in relation to the outer clamping segments (24) and thus causing the friction surface (27) to expand outwards and grip the inner diameter of the casing section (2).

The lifting tool lifting part (20) in the preferred embodiment is configured for rotation about the axial piston rod (47), such that the lifting part (20) with the pipe length (3,4) is configured for a controlled threading of the pipe length (3) onto a standing pipe-string (2), and where the lifting part (20) is configured for carrying part or all of the weight of the standing pipe-string (2).

The lifting part (20) inner clamping rings (29) can be attached to the piston rod (47) via a bearing cylinder (22), which is attached to a coaxial base plate (30), which in turn is fixed to the piston rod (47) with an adapter (48) and locked in place with a hex nut (143,144).

The lifting part (20) outer clamping segments (24) and inner clamping rings (29) are preferably arranged in pairs in several levels between the base plate (30) and top plate (21). The outer clamping segments (24) can also be separated axially by spacing rings (26).

The lifting tool hydraulic system (40) is preferably a double acting hydraulic cylinder mechanism consisting of a hydraulic cylinder (42) with a cylinder base (44) and cylinder head (41) and a piston (43) arranged concentric and attached to the axial piston rod (47).

Activation of the lifting tool can by accomplished by supplying pressurised hydraulic oil via a preferably radial inlet (50) in connection with the anchor part (5) and via a primarily

vertical hydraulic passage (51) for hydraulic oil through the piston rod (47) and with a radial outlet for the hydraulic oil from the piston rod (47) under the piston (43) to activate the piston (43) upwards.

Deactivation of the lifting tool is achieved when pressurised hydraulic oil is supplied from the hydraulic cylinder (42) upper part over the piston (43) to drive the internal clamp rings (29) downwards such that the outer clamp segments (24) with friction coating (27) are retracted from and release their grip on the inner diameter of the pipe length (3,4).

The lifting part (20) is preferably capable of rotation about a horizontal axis and configured for grasping a horizontal or near horizontal laying pipe length (3,4).

An additional advantage provided by a lifting tool according to the invention is that circulation of drilling fluids, cement or other fluids to the bore hole or well (160), can be achieved via the lifting tool. The lifting tool can be configured for circulation of drilling fluids via a flexible hose (7) connected to the lifting tool support (5) and via the piston rod (47) in the lifting tool lifting part (20).

The lifting tool lifting part (20) can for this purpose encompass a connector (6) which is attached to the flexible hose (7), preferably a high pressure hose (7) with the help of a union (7a) and a bolted goose neck connection (8), preferably with a swivel, for transfer of drilling fluid, drilling mud, cement or other fluid to the piston rod (47) in the lifting part (20), connected to a manifold or adapter (9) for venting of air during application of drilling fluid, drilling mud, cement or other fluid form the top drive (60).

The lifting tool lifting part (20) can be hung free to rotate from the elevator device (70) from the piston rod (47), preferably via a shoulder or recess on the piston rod (47).

A tilting arm (10) can facilitate rotation of the lifting part (20). The tilting arm (10) in one embodiment has one end (10a) arranged concentrically around the piston rod (47), and the

other end (10b) which is connected to a telescoping hydraulic lifting cylinder (61) mounted on the top drive (60), preferably with a chain or other suitable connection.

The lifting tool lifting part (20) can preferably include a locking mechanism, where locking slots (5a) are oriented concentrically around and connect to the piston rod (47), where the tilting arm (10) is movable under pressure, preferably with a spring loaded joint (10a) in the tilting arm (10), and where the movable tilting arm (10,10a) is arranged for movement from an initial unlocked position passively engaging upon rotation of the lifting part (20) in one of the locking slots in the slotted flange (5a) to a locked position, preventing rotation of the entire lifting tool. The spring loaded joint (10a) is arranged for unlocking the tilting arm (10) upon retraction of the spring loaded joint (10a) from a position where the lifting tool lifting part (20) has moved from an initial position and returned to the initial position.

The lifting tool according to claim 37, where the lifting part (20) encompasses an entry cone or expanding packing (140) (mud packer), preferably an elastomer packing (140), arranged concentric to the piston rod (47), arranged for entering the end of a pipe length (3,4) and to expand against the pipe length (3,4) inner diameter upon activation of the lifting tool, and where the entry cone (140) is fixed to the piston rod via a bolted connection (143,144).

The piston rod (47) can in one embodiment (see figure 14) encompass a passage for application of drilling fluid, drilling mud, cement or other fluid or fluid mix, and another passage (148) for venting of air during application of drilling fluid, drilling mud, cement or other fluid or fluid mix.

The lifting tool lifting part (20) can also be configured for one or more independent sensors (15), preferably spring loaded pressure sensors, for determination of the entry cone (140) position with reference to the end of the pipe length (3,4), and where each sensor (15) is connected to a limit switch (14).

External Running Lifting Tool (ERE)

Figure 3a-b are schematic views of another embodiment of a lifting tool according to the invention, here shown in a configuration where the lifting tool encompasses a clamping system which grips the outside diameter of one end of a pipe length or pipe-string. Figure 3a shows a lifting tool in the inactive or deactivated condition, ready to grip the top of a threaded pipe length, fig. 3b shows the lifting tool in the activated or engaged condition.

The lifting tool can manipulate and lift oil & gas well casing strings (2) and sections (3,4) during connecting and installation or extraction and removal of casing or conductor, risers, drill strings, or other tubular goods, in a well (160) or bore hole (160). The lifting tool consists of a lifting part (20) with a coaxial piston rod (47), a mounting interface part (5) for connection to a top drive (60) providing lifting force, or derrick crane (60), and a hydraulic system (40) which is designed to hold the lifting part (20) fixed to the outer diameter of the end of the pipe length (3).

The novelty of this lifting tool is that the lifting tool lifting part (20) includes a clamping system with one or more pairs of internal clamping segments or clamping rings (29) and outer clamping segments (29), where the lifting part (20) with the clamping system is configured to grip the outer diameter of the end of a pipe length (3,4) below the threaded section of the pipe length (3,4), and where the clamping system is configured to be self locking such that the pipe length (3,4) own weight will increase the clamping force and thus prevent any loss of grip on the pipe length (3,4) in the event of hydraulic system failure.

The lifting part (20) is preferably capable of rotation about a horizontal axis and configured for grasping a horizontal or near horizontal laying pipe length (3,4); and where the lifting tool lifting part (20) in the preferred embodiment is configured for rotation about the axial piston rod (47), such that the lifting part (20) with the pipe length (3,4) is configured for a controlled threading of the pipe length (3) onto a standing pipe-string (2), and where the

lifting part (20) is configured for carrying part or all of the weight of the standing pipe-string (2).

One of the many advantages provided by a lifting tool according to the invention is that circulation of drilling fluids, cement or other fluids to the bore hole or well (160), can be achieved via the lifting tool. The lifting tool can be configured for circulation of drilling fluids via a flexible hose (7) connected to the lifting tool support (5) and via the piston rod (47) in the lifting tool lifting part (20).

The piston rod (47) can encompass a lifting flange (48) configured to transfer load forces from the lifting tool piston rod (47) to the lifting tool lifting part (20). The piston rod (47) can also include a passage to accommodate the addition of drilling fluid, drilling mud, cement, or other fluid or fluid mix and another passage for venting of air during the addition of drilling fluid, drilling mud, cement, or other fluid or fluid mix.

The lifting part (20) can encompass a connector (6) which is attached to a high pressure hose (7) with a union (7a), for the addition of drilling fluid, drilling mud, cement, or other fluid or fluid mix from the top drive (60); and a bolted goose neck connection (8), preferably with a swivel, for application of drilling fluid, drilling mud, cement, or other fluid or fluid mix to the piston rod (47) in the lifting part (20), connected to a manifold or adapter (9) for venting of air during application of drilling fluid, drilling mud, cement, or other fluid or fluid mix from the top drive (60).

The lifting tool lifting part (20) is hung free to rotate from the elevator device (70) from the piston rod (47), preferably via a shoulder or recess (13) on the piston rod (47).

A tilting arm (10) can facilitate rotation of the lifting part (20). The tilting arm (10) in one embodiment has one end (10a) arranged concentrically around the piston rod (47), and the other end (10b) which is connected to a telescoping hydraulic lifting cylinder (61) mounted on the top drive (60), preferably with a chain or other suitable connection.

For gripping the pipe length (3,4) the lifting part (20) can encompass an entry cone (141) with a compliant support ring (146), where the entry cone (141) is configured to envelope an end of the pipe length or pipe-string (2,3,4) and clamp against the outside diameter of the pipe length or pipe-string (2,3,4).

The lifting tool hydraulic system (40) is preferably a double acting hydraulic cylinder mechanism consisting of a hydraulic cylinder (42) with a cylinder base (44) and cylinder head (41) and a piston (43) arranged concentric and attached to the axial piston rod (47).

Activation of the lifting tool can by accomplished by supplying pressurised hydraulic oil via a preferably radial inlet (50) in connection with the anchor part (5) and via a primarily vertical hydraulic passage (51) for hydraulic oil through the piston rod (47) and with a radial outlet for the hydraulic oil from the piston rod (47) under the piston (43) to activate the piston (43) upwards.

Deactivation of the lifting tool is achieved when pressurised hydraulic oil is supplied from the hydraulic cylinder (42) upper part over the piston (43) to drive the internal clamp rings (29) downwards such that the outer clamp segments (24) with friction coating (27) are retracted from and release their grip on the inner diameter of the pipe length (3,4).

The lifting tool hydraulic system (40) can also include a supply passage (51) for hydraulic oil to one side of the hydraulic piston (43) in the hydraulic cylinder (42), and an outlet passage (52) for hydraulic oil to the other side of the piston (43) in the hydraulic cylinder (42), where the inlet passage (51) and the outlet passage (52) run through the piston rod (47) from the manifold (9).

There can be arranged an indicator or sensor system as a part of the lifting tool lifting part (20). The lifting part (20) can for example include one or more independent sensors (15), preferably spring loaded pressure sensors, for determination of the lifting nipple (32) position

with reference to the end of the pipe length (3,4), and where each sensor (15) is connected to a limit switch (14).

The lifting tool lifting part (20) can preferably include a locking mechanism, where locking slots (5a) are oriented concentrically around and connect to the piston rod (47), where the tilting arm (10) is movable under pressure, preferably with a spring loaded joint (10a) in the tilting arm (10), and where the movable tilting arm (10,10a) is arranged for movement from an initial unlocked position passively engaging upon rotation of the lifting part (20) in one of the locking slots in the slotted flange (5a) to a locked position, preventing rotation of the entire lifting tool. The spring loaded joint (10a) is arranged for unlocking the tilting arm (10) upon retraction of the spring loaded joint (10a) from a position where the lifting tool lifting part (20) has moved from an initial position and returned to the initial position.

The lifting tool preferred embodiment comprises:

- a lifting part (20) which encompasses a coaxial piston rod (47), and a support part (5) for attachment to and receive lifting power from a top drive or derrick crane (60)
- a hydraulic system (40) which is configured to lock the lifting part (20) to the outer diameter of the end of a pipe length (3,4), where the hydraulic system (40) with a hydraulic piston (43) connected to the piston rod (47) and arranged in a hydraulic cylinder (42)
- a clamping system I the lifting tool lifting part (20) with one or more pairs of inner (24) and outer clamping segments (29), where the lifting part (20) with clamping system is configured to grasp the end of a pipe length (3,4)
- an outer housing (16) with a top plate (21), and where the outer housing (16) encompasses a main lifting shoulder (18) and base plate (19) with a central opening for receiving a pipe length (2,3,4) to be grasped

- a bearing cylinder (22) with a guide or stop plate (22b), a bearing cylinder base (22d) with central opening, a center plate (22e) and an internal bearing cylinder (22f);

where the pressure on the piston (43) upon application of hydraulic pressure pushes the piston (43) and the piston rod (47) and the outer housing (16) upwards together with the outer housing base plate (19) and the outer clamping segments (24), such that the bearing cylinder (22) and the stop plate (22b) with the inner clamping segments (29) are pushed downwards in relation to the outer clamping segments (24) with the result that the inner clamping segments (29) are forced inwards to clamp against the pipe length (3,4) outer diameter.

The outer housing (16) can also include a top plate unit (17), for example as described earlier for the INTRE and IRE. The outer housing top plate unit (17) can include at least one and preferably two plates (17a,b), each with a central opening; one or more web sections (17c) configured for stiffening of the top plate unit (17) and oriented primarily normal to the and between the top plates (17a,b), and where the web sections (17c) are attached to the top plates (17a,b) preferably with a welded connection; a mounting plate (149) arranged on the outside of one of the plates (17a); and a self lubricating bushing arranged between a lifting flange (48) on the piston rod (47) and the other top plate (17b).

A major advantage of this embodiment is that the clamping system is self-locking wand will develop increased locking force as the weight carried by the lifting tool increases (weight energised locking).

Lifting System

Figures 4a-b to 12a-b illustrates how a lifting system according to the invention can function.

The lifting system can lift or lower pipe length (3,4) and a pipe-string (2), during joining and lowering or lifting and disassembling of conductor, casing, riser, drill string or similar in a bore hole (160) or well (160). The lifting system consists of a lifting tool with a lifting part (20) and a support part (5) connected to an elevator device (70) which is mounted in a top drive (60) and where the lifting part (20) shall work in conjunction with a power slip (150) which is configured to receive and hold a standing pipe length length or pipe-string (2);

The novelty of the lifting system is described as follows:

- the lifting tool lifting part (20) is configured for easy installation and removal from an elevator device (70);
- the elevator device is configured to orient the lifting part (20) such that the lifting tool can engage the end of a pipe length (3,4) and be activated;
- the elevator device (70) and the lifting tool upon the application of lifting force and activation of the lifting tool lifting part (20) is configured to lift the lifting tool lifting part (20) with the pipe length (3,4) for joining with or mounting on the pipe-string (2) below; and
- the lifting tool and lifting tool support part (5) are configured for application or circulation of drilling fluid, drilling mud, cement or other fluid or fluid mix to the bore hole or well (160).

The lifting tool lifting part (20) can be configured for replaceable / removable use in the elevator device (70), preferably in an upper section or lifting shoulder (13) of the piston rod (47). The lifting tool lifting part (20) can also be configured for about a horizontal or near horizontal axis, in the elevator device (70), to engage an end of a horizontal or near horizontal pipe length (3,4), and to grip the inner or outer diameter of the end of the pipe length (3,4).

The lifting system in another embodiment of the invention encompasses a rotation apparatus (power tongs) (80) which is configured for rotation of the lifting tool lifting part (20) with the pipe length (3,4) about the piston rod (47), for a controlled threading of the pipe length (3,4) together with the standing pipe-string (2), and where the lifting tool lifting part (20) is configured to carry all or part of the resulting load of the resulting pipe length (2).

The rotation apparatus (80) can for example include a clamping device, or a pair of power tongs (81) which are configured to hold fixed a pipe length or pipe-string (2), and a torque device or second set of power tongs (82) configured for rotation of the lifting part (20) and pipe length (3,4) for joining with the pipe-string with the help of a torque or rotation motor.

The lifting tool can be configured to receive lifting force from a top drive (60) for activation of the lifting tool, such that the lifting tool after activation of the lifting tool lifting part (20) against the pipe length (3,4) inner or outer diameter, is capable of lifting the pipe length (3,4) or pipe-string (2,3,4), and directed to a rotary table (161) for joining of the pipe length (3,4) with the pipe-string (2) below.

A pipe handling machine (tube feeding machine) can be arranged for placing pipe length (3,4) in position for engagement by the lifting tool lifting part (20).

The lifting system can also include a manipulator arm (170) for placing the far end of a pipe length (3,4) from the pipe handling machine (180) to the vertical position over the standing pipe-string (2) below.

The elevator device can be of any type. One example us such an elevator device appropriate for use is the BX-Elevator, manufactured by VarcoBJ, USA, which has replaceable adapters for differing pipe length diameters, however other types of elevators can be used. On such elevator device (70) can include and elevator (71),

where the elevator (71) is mounted capable of rotation in two link arms (75), where a hydraulic motor is used for rotation of the elevator (71) about the axis defined by the link arm supports, and which is held by a clamping mechanism, preferably a parallel link (76), such that the link arms do not rotate in relation to each other. The elevator (71) encompasses adapters (74) for varying pipe length diameters and the elevator itself is available in different sizes.

Method for Lifting of Pipe lengths for joining to a Pipe string

The method for lifting of pipe length (3,4) for jointing to a pipe-string (2), as well as conductor, casing, risers, or similar for use in a bore hole or well (160) with the use of a lifting system and lifting tool is illustrated in fig. 4a-b to 12a-b. The method includes the following steps:

- the pipe length (3,4) into position with the lifting tool lifting part (20)
- the lifting tool lifting part (20) engages one end of the pipe length (3,4) which will be the upper end of the pipe length (3,4)
- the lifting part is activated by a hydraulic system (40) to clamp the inner or outer diameter of the pipe length (3,4)
- a top drive or derrick crane (60) lifts the lifting tool with the pipe length (3,4) to the vertical or near vertical position over a standing pipe length or pipe-string (2)
- the lower end of the now vertical or near vertical pipe length (3,4) is joined with the standing pipe-string (2) below to create a lengthened pipe-string (2)
- the resulting pipe-string (2) is lowered and held in position by a power slip (150) which is configured to hold the pipe-string (2) in the drilling deck
- the resulting pipe-string (2) is released from the power slip (150) such that it hangs from the top drive (60) and lifting tool

- the resulting pipe-string (2) is lowered and again held in place by the power slip (150); and
- the lifting tool is released from the end of the resulting pipe-string (2)

The method can also include the following step:

- the lifting tool support part (5) is placed or held in the elevator device (70), preferably it an upper part or lifting shoulder (13) on the piston rod, prior to the pipe length (3,4) being positioned for engagement by the lifting tool

The method can also include the following step:

- the lifting tool lifting part (2) is rotated about a predominantly horizontal axis in a elevator device (70), with the help of a tilting arm (10) which in one end is fixed to the lifting tool support part (5) and in the other end to a lifting cylinder (61) if the top drive (60), from a predominantly vertical initial position to a position ready for engagement with the horizontal or near horizontal pipe length (3).
- the pipe length (3) is moved forward and into the lifting tool lifting part with the help of a tube feeding machine (TFM) for activation of the lifting tool lifting part (20)

The method can also include the following step:

- as the pipe length (3) is moved forward on the tube feeding machine (TFM), the other end of the pipe length (3) is moved to the standing pipe-string (2) by a manipulator arm (170); and
- the lifting tool and pipe length (3) are lowered to the standing pipe-string (2) for joining with the standing pipe-string (2)

The method can also include the following step:

- joining of the pipe length (3) and the pipe-string (2) is accomplished by threading of the opposite end of the pipe length (3) into the threaded end of the pipe-string (2)

through rotation of the lifting tool lifting part in the upper end of the pipe length (3) about the lifting tool main axis with the use of a rotation system (80).

The method can also include the following step:

- upon activation of the lifting tool a clamping system (24,29) in the lifting tool lifting part (20) clamps against one or both of the pipe length (3,4) inner and outer diameters with the use of a piston hydraulic system (40).

The method can also include the following step:

- upon activation of the lifting tool an entry cone or expanding packing (140) is pressed against the pipe length (3,4) inner diameter.

The method can also include the following step:

- threading of a lifting nipple (32) into the threaded end of the upper or next upper end of the pipe length (3,4), preferably with the help of a nipple rotation system (90).

The method can also include the following step:

- upon release of the lifting tool from the pipe-string (2), the clamping system (24,29) in the lifting tool lifting part (20) is released from the pipe-string (2) end with the help of the hydraulic system (40), such that the lifting tool can be moved to a start position.

The method can also include the following step:

- upon release of the lifting tool from the pipe-string (2), the lifting nipple (32) is screwed out of the threaded end section of the pipe-string (2), preferably with the help of the nipple rotation system (90), or manually with the help of a manual release system for the lifting nipple, and thereafter release the clamping system (24,29) from the pipe-string (2) end.

The method can also include the following step:

- progress in the feeding of the pipe length (3) is monitored by an indicator system, preferably with on or more independent sensors (14,15) each connected to a limit

switch, which ensure that the feeding of the pipe length is stopped at the appropriate moment to avoid damage to the end of the pipe length, and which indicates centering of the lifting tool lifting part (20) in the end of the pipe length (3,4) to be grasped by the lifting tool.

Example of method for use of a lifting system according to the invention, where the lifting tool encompasses an internal running lifting nipple

The following describes an example of the method for joining of pipe length (3,4) and pipe-string (2).

The lifting tool hangs from an elevator and is swung / tilted up with the help of a lifting cylinder (61) to the desired angle, such that the angle between the lifting cylinder (61) and the vertical axis of the rotary table (161) matches the angle between the horizontal plane and the central axis of the pipe length (3) laying ready for the tube feeding machine (TFM). Thereafter the pipe length (3) is driven into the lifting tool until the indicator or sensor system (14,15) shows that the pipe length has come into the proper position. Furthermore the lifting tool is activated by a hydraulic system (40). A clamping system with outer clamping segments (24) and inner clamping segments (29,29a) clamp about the pipe length (3) outer diameter with the required force. An internal running entry cone, or elastomer packing or cylinder (140) expands outward against the inner diameter of the pipe length (3) such that the required holding force is generated, and the lifting tool is centered in the pipe length (3). Should the lifting tool fail to be properly centered in the pipe length, there is a risk that the lifting nipple (32) could be subjected to an amount of bending due to its own weight, which can result in damage to the threaded end section of the pipe length. This can result in the requirement that the pipe length must be removed and replaced, which is a time consuming and expansive operation.

The lifting nipple (32) is screwed into the threaded end section of the pipe length with the help of the nipple rotation system 90.

When the lifting tool is engaged into the end of the pipe length (3), there is an automatic locking of the lifting tool to the tilting arm (10) to prevent rotation of the pipe length (3) during the threading in of the lifting nipple (32) while the pipe length lays in the tube feeding machine.

The lifting process begins with the top drive providing lifting force to and lifting the elevator device (70) with the lifting tool and the pipe length (3), simultaneously the tube feeding machine (TFM) drives the pipe length towards the rotaty table or rotary table axis (161). The hydraulic system for the top drive (60) lifting cylinder (61) and elevator device is released. The pipe length is thereafter lifted to the primarily vertical position. A manipulator arm holds and leads the opposite end of the pipe length (3) to be handled in the rotary table (161).

When the lifting tool has lifted the pipe length (3) into the primarily vertical position for joining with the standing pipe-string (2) below held in place by the power slip (150), the connection between the lifting tool and the lifting cylinder (61) is loosened such that the lifting tool lifting part (20) with the pipe length (3) is free to rotate about the primary axis of the lifting tool.

A power tong set (81) is placed on the pipe-string (2) which is held by the power slip or clamping arrangement and holds the pipe-string (2) in the fixed position, to prevent rotation of the pipe length or pipe-string. A second set of power tongs (82) engage the opposite end of the pipe length (3) which is to be screwed into the pipe-string (2) which is held by the power slip or clamping arrangement (150), and begins threading the pipe length (3) onto the pipe-string (2) held by the clamping arrangement or power slip (150).

The resulting pipe-string (2) is lifted such that the power slip can release its grip on the pipe-string (2). Thereafter the resulting pipe-string (2) is lowered to a position where it can again be held in place by the power slip (150).

The lifting tool is released by un-screwing the lifting nipple (32), and subsequently operating the hydraulic piston (43) on the piston rod (47) in the hydraulic cylinder (42) downwards such that the clamping system in the lifting part (20) and the entry cone (141) are released from the pipe-string (2) outer diameter, and the entry cone (140) is disengaged from the pipe-string (2) inner diameter and returns to its original form. The lifting tool can now be lifted to the desired standby position. A new pipe length is fed forward, and the process can start again as needed.

The lifting system with a lifting tool according to the invention has several advantages; it can lift a pipe length (3) for joining with a standing pipe-string (2) below, the lifting tool lifting part (20) can rotate about the piston rod (47), and it is possible to fill or circulate drill fluid via the lifting tool to the bore hole, for example drilling mud, to maintain pressure in the bore hole or well (160). The lifting tool can also be used with varying pipe length dimensions. The lifting nipple in the lifting tool with internal running lifting nipple (32) can be manufactured with varying thread types, while the lifting nipple flange (33) threads are matched to the lifting shoulder on the lifting tool.

List of part number references

1	lifting tool
2	a second pipe length or pipe string
3	the first length of pipe to be lifted and joined with pipe length or pipe string (2)
4	a third pipe length to be joined with the first pipe length (3)
5	connection piece
6	adapter for supply of drilling fluid, drilling mud
7	high pressure hose for drilling fluid, drilling mud
8	bolted goose neck connection, preferably with swivel
9	manifold / adapter for hydraulic fluid and venting of air
10	tilting arm for lifting assistance
11	compensating joint, for example a spring loaded joint
10b	locking system for prevention of rotation of lifting part (20) during in-threading of lifting nipple
11	internal threads in the end of a pipe length (3,4) or pipe string (2)
12	external threads in the other end of a pipe length (3,4)
13	recess / lifting shoulder on the piston rod (47)
14	limit switch
15	indicator or sensor system to verify that the lifting tool has the proper position with respect to the pipe length to be lifted; can be a spring loaded indicator to determine when the lifting nipple is in the correct position for lifting, preferably one or more sensors which are independent of each other where each sensor is connected to a limit switch (14)
16	housing for internal running lifting tool with threaded nipple or clamping system, in fixed position

17	top plate unit for lifting part (20)
17a,b	circular disks / plates with central hole
17c	web stiffeners welded into position between 17a,b to stiffen the top plate unit 17
17d	cylinder with spindle system for inlet (95), outlet (96) and case drain (97) of hydraulic oil for the nipple rotation system (90)
17e	spindle system
18	main lifting shoulder
19	base plate for top plate unit (17)
20	lifting part
21	top plate of lifting part (20)
21a	self lubricating bushing positioned between the top plate unit (17), or top plate (21), and lifting flange (48) on the piston rod (47)
21b	
22	bearing cylinder
22a	top plate for bearing cylinder (22)
22b	guide or stop plate with lifting flange (22c)
22c	lifting flange
22d	bearing cylinder plate with central hole
22e	central plate
22f	inner bearing cylinder
23	metal inserts
24	outer clamping segments or outer clamping rings
25	mounting ring for bolts (31a) which hold base plate (30)
26	distance pieces / spacing rings
27	friction coating

28	metal or composite friction inserts
29	inner clamping segments or inner clamping ring
29a	gasket on the inner clamping segments or inner clamping ring
30	base plate for lifting part
31a	bolts which fasten base plate (30)
31b	bolts which fasten entry cone (140)
31c	bolts for fixing ring (146)
32	lifting nipple
33	lifting nipple flange
34	external threads on the lifting nipple cone (36)
35	internal threads on the lifting nipple
36	hollow coaxial lifting nipple axle
36a	external threads on lifting nipple axle
37	lifting nipple cone
38	coaxial guide tube
38a	external threads on the coaxial guide tube (38)
38b	internal threads on the coaxial guide tube (38)
39	spring system, spiral springs or spiral krans
40	hydraulic piston
41	piston cylinder plate
42	hydraulic cylinder
43	piston
44	piston cylinder base
44a	base gasket in the hydraulic cylinder (42)
45	bolts for fastening of the hydraulic cylinder (42) to the piston cylinder base (44)

46a,b first and second o-rings

47 piston rod

48 lifting flange on piston rod (47)

48a spacer

49 piston rod hex nut for base plate

50 inlet for hydraulic oil

51 inlet passage for hydraulic oil to one side of the piston (43) in the hydraulic cylinder (42)

52 outlet passage for hydraulic oil from the other side of the piston (43) in the hydraulic cylinder

53

60 torsionally rigid support / derrick crane / drive unit / top drive / drilling machine

61 telescopic hydraulic driven lifting cylinder with chain connection to tilting arm (10)

62 support arrangement for mud / hydraulic hose

64 support for link arms which are capable of rotation about a horizontal axis

65 bearing

66

67

68

70 elevator device, for example a BX elevator where there is an arrangement of removable adapters for differing pipe diameter, where the adapters can include lifting shoulders. Found on most drill rigs / production ships.

71 elevator

72 hydraulic motor for rotation of elevator (71)

73

74 removable adapters for elevator (71)

75 link arms, one or more capable of rotation anchored in the elevator (71)

76 clamp / parallel link for holding link arms such that they do not rotate with respect to each other

80 rotation apparatus

81 power tongs / clamping device one or more sets, first to hold lowered pipe string (2)

82 power tongs / clamping device one or more sets, second to rotate lifting tool with pipe string (2)

83 torque / rotation motor for rotation of lifting part (20) and pipe length (3,4) to be joined with lowered pipe string (2)

90 nipple rotation system

91 hydraulic motor

92 mounting bracket for hydraulic motor

93 gear sprocket for rotation of lifting nipple

94 axle for gear sprocket (93)

95 inlet passage for hydraulic oil to hydraulic motor (91)

96 outlet passage for hydraulic oil from hydraulic motor (91)

97 case drain passage

100

110 swing damper

120 inspection opening

121 lugs for manually loosening lifting nipple (32) for example with the use of a lever / bar, in the event that it is required, for example a fault in the nipple rotation system hydraulic passages.

130

140	entry cone
141	entry guide
142	expanding elastomer or rubber seal / mud packer
143	fastening bolt for piston rod
144	distance pieces / spacer washers for fastening bolt (143)
145	seal plate between piston rod (47) and
146	backing ring
147	passage for drilling fluid, drilling mud
148	passage for venting of air
149	mounting plate for disk on top of top plate unit
150	power slip, clamping system in the drill floor which is configured for holding a pipe length or pipe string(2)
151	inner clamping ring in power slip
152	outer clamping ring in power slip
153	rotary support table
154	hydraulic motor which control opening and closing of rotary support table (153)
155	doors in the power slip (150)
160	bore hole or well
161	rørsenter
170	manipulator arm
180	tube feeding machine